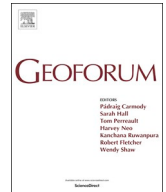




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Robo-advisors and the financialization of lay investors

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ABSTRACT

The burgeoning financial technology scene in Singapore has seen the emergence of robo-advisors, which aim to disrupt traditional financial advisories by using algorithms to automate client advising and investment recommendations. Using an ecologies concept to explore how lay investors are articulated into global financial networks through robo advisors, this paper contributes to studies on the “financialization of everyday life”. It argues that investors are rendered passive by the disciplinary tools of algorithms, contemporary finance theories and elements of robo-advisor platforms that feed into these sociotechnological assemblages. The state’s role in embedding citizen investors in these human-machine relationships is considered. The fragmented landscape of free, nonprofessional online financial advice and the opaque qualities of investing algorithms make investor subject formation incomplete and uncertain, especially when markets are highly volatile. This paper explores how both financial inclusion and exclusion operate simultaneously in robo-advisors and argues that robo-advisors may weaken efforts to promote financial literacy and education.

1. Introduction

A recent survey conducted by Singapore bank OCBC painted a worrying picture of personal financial security in the country. One in three adults did not invest or engage in growing wealth, while more than 70% percent were not sufficiently prepared for retirement, being acquainted mostly with only savings and insurance products (Lee, 2019). This contrasts starkly against the prestigious position of the nation-state as a vibrant international financial center (IFC). To maintain its IFC status, Singapore has enthusiastically embraced financial technology (“fintech”), broadly referred to as the use of technology to innovate and improve the delivery of financial services.

Efforts to digitalize the finance industry have brought forth new actors and platforms. Among the plethora of new fintech products and services that seek to disrupt traditional finance are robo-advisors,¹ which use artificial intelligence to manage investor portfolios with little or no human involvement. Robo-advisors were first started in the United States around 2007–08 as a way for individual (retail) investors to manage their financial affairs cheaply in lieu of a dedicated human financial advisor. In Singapore, a number of homegrown and foreign robo-advisors have emerged to compete for retail investor dollars. As new startups, they promise to ‘shake up’ the local financial scene that is mostly dominated by the incumbents, namely big banks and wealth management companies. They do this by offering well-diversified

portfolios at low cost. While software-driven portfolio management strategies are already used in current financial advisory practice, replacing human advisors with investment algorithms has disintermediated the traditional distribution channel, where the latter often involves costly fees and heterogeneous financial advice that hinges on the advisor’s skill and experience level. Robo-advisors are a financial innovation that delivers low cost and convenient financial management to retail investors.

The increased digitalization of financial practices calls for a deeper inquiry into the role of non-human actors in enrolling consumers into the financial system. Studies have explored how robo-advisors promote the formation of healthy investor subjects by reducing risk through automating portfolio diversification and correcting behavioral (cognitive and emotional) bias (D’Acunto et al., 2019) and examined the factors influencing their adoption (Belanche et al., 2019). While Hayes (2019) has focused on the disciplining power of sociotechnical assemblages of robo-advisors in controlling investor behavior, the role of robo-advisors in shaping the experiences of financial subjects within the financialization of daily life has not been studied thus far.

This paper complements existing studies that have explored financialization from a technological development perspective (e.g. Marron, 2007). By viewing robo-advisors as socio-technological assemblages, this paper shows how the automated provision of financial advice as deployed through algorithms and web-enabled platforms can

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¹ Robo-advisors, which perform the dual functions of providing investment advice and managing the investor’s portfolio, are sometimes referred to as robo-investors, although the former term is more commonly used.

enroll financial subjects, particularly those with little or no investing knowledge, into global financial networks. The variegated financial ecologies that are produced by robo-advisors contribute to a richer characterization of investor subject formation. With robo-advisors, investors are no longer entrepreneurial risk takers who are responsible for saving and investing for a secure future (Clark, 2000). Instead, they become passive financial subjects who are pre-sorted into various risk profiles and matched to particular risk-calibrated portfolios with pre-determined asset allocations.

This paper also highlights the role of robo-advisors as an emerging, non-human intermediary in investor subject formation. While the literature has touched upon the role of human intermediaries like financial advisors (Lai, 2016) and state institutions (Lai and Tan, 2015) in shaping investor attitudes, knowledge and practices, the role of digital advisory services i.e. robo-advisors as an emerging form of socio-technical agencement (Callon, 2005) has been relatively underserved thus far. Applying the ecologies concept to this paper combines two strands of the financialization literature: one on the financialization of the everyday (French and Kneale, 2009; Langley, 2007) and the other on financial subject formation (Lai, 2016; Langley, 2007).

The ecologies concept and other metaphorical cousins, such as network, assemblage and apparatus enable a more spatially attuned analysis that acknowledges the plurality in financial knowledge and practices as they unfold and evolve across space. Another key utility lies in its focus on the unevenness in connectivity and socio-material outcomes. As argued by Lai (2016: 30), “the ecologies concept can offer more topological finesse around questions of why particular sets of relations are more durable or porous, allowing for more precise consideration of power in relational thinking”. This paper considers the linkages between robo-advisor firms and lay investors, where algorithms exercise social power in conditioning the emergence and disciplining of financial subjects. Robo-advisors manage investors “at a distance” by reshaping the client-advisor relationship into one that is more impersonal and provides less customized advice than that traditionally offered by human advisors.

This study situates robo-advisors within a unique state-facilitated environment, where government-run pension-savings schemes coupled with the state’s fintech hub development agenda create an attractive pool of funds to be harnessed by robo-advisors. It illustrates how state-facilitated efforts reconfigure state-subject relations, allowing citizen investors to be drawn towards robo-advisors as a viable, government-approved way of wealth accumulation. This adds to recent work by Lai and Tan (2015) who argue for the continued relevance of the state in actively shaping financialization processes of the everyday. Furthermore, lay novice investors navigate a fragmented and dissonant information landscape when choosing a robo-advisor. This is marked by transient relationships among non-professional members of online knowledge communities, shifting the burden of information gathering and decision making to the investor.

Robo-advisors’ algorithmic practices sort investors into risk categories that expose them to different portfolio allocations of varying risk and time horizons. This paper argues that the human-algorithm assemblage constitutes a new mechanism where investors are simultaneously articulated into broader financial markets and disciplined by the robo-advisor into passive investors. I show that investors are encouraged to refrain from active portfolio management. The tensions between the mission of robo-advisors to democratize investing and their involvement in exclusionary practices in forming passive investor subjects allow a deeper conceptualizing of both financial inclusion and exclusion that operate simultaneously in robo-advisors. This tempers prevailing arguments that extoll the benefits of new financial technologies in opening up participation and access to the financial markets to the masses.

The paper is organized as follows. The proceeding section reviews the financialization literature and discusses financial ecologies as an analytical frame in mapping the variegated relationships in financial

subject formation. Section 3 gives an overview of robo-advisors and the robo-advisory scene in Singapore and outlines the methodology. Section 4 analyzes the ways robo-advisors conjure passive investors and explores the state’s role in embedding individuals within investor-algorithm relations. It also explores the changing environment of financial advice provision as characterized by investors’ fleeting encounters on online forums and blogs. Section 5 considers the inclusionary and exclusionary forces in robo-advisors and explores how robo-advisors may weaken efforts to promote financial literacy and education. The final section concludes the paper.

2. Financialization, intermediaries and ‘financial ecologies’

Financialization has been well-studied across the social sciences. While the concept of financialization has evolved over time, two classic definitions have endured: a ‘pattern of accumulation in which profits accrue primarily through financial channels’ (Krippner, 2005: 174), and Epstein’s (2005) definition of the ‘increasing role of financial motives, financial markets, financial actors and financial institutions’ (p. 3). This paper adopts the latter definition as it is focused on exploring the ways finance is rooted in the everyday lives of individuals and households (Aitken, 2007; Martin, 2002).

The financialization of the everyday is situated within broader processes of neoliberal governance, where the state has delegated responsibility for financial planning and retirement to individuals and private markets. As a result, individuals are encouraged by both the state and financial institutions to become financially responsible subjects (Lai and Tan, 2015). By transforming themselves into entrepreneurial risk-takers who take advantage of technological innovations like pension funds (Clark, 2000), they hope to secure their financial future by integrating themselves into the global financial system. Under these changing financial subjectivities, the normalization of risk and acceptance of risk-taking actions are reflected in the increased consumption of retail financial products, aided by technological and institutional developments like credit scoring and pension fund reforms (Lai, 2018).

Attendant scholarship on financialization includes themes pertaining to financial literacy and financial inclusion (exclusion). The former focuses on the socioeconomic of financial literacy and its uneven impacts (Lusardi and Mitchell, 2014) and highlights the need to raise literacy levels through the imparting of financial knowledge. This paper argues that robo-advisors as a financial intermediary may impede financial literacy, because automated investing brings forth passive investors who delegate decisions to algorithms without much need to be financially savvy. Financial exclusion is seen in uneven access to retail bank services following bank branch closures (Leyshon et al., 2008), while inclusionary forces shape the remaking of citizens into entrepreneurial subjects who participate in financial markets to improve their financial security (Lai and Tan, 2015). This paper argues that robo-advisors produce both financial inclusion and exclusion. Rather than operating as separate forces, individuals are simultaneously articulated into broader financial markets and yet are actively excluded from portfolio management by robo-advisors. This gives a more nuanced interpretation to the usual framing of financial inclusion and exclusion as distinct and mutually exclusive forces.

At the same time, financialization is becoming increasingly digitalized with the fintech phenomenon gaining rapid traction. The fintech revolution has seen the proliferation of new online, automated platforms that aim to simplify financial services delivery in traditional areas such as savings and investing. This study contributes to the literature on everyday financialization through the lens of digitalization. It elucidates how robo-advisors have emerged as an important yet understudied intermediary in the articulation of households into global financial circuits by simplifying investing through automation, and in shaping individuals’ financial knowledge and investing practices.

Ethnographic accounts of financial intermediaries inspired by

Callon's (2005) reading of agencement have generated considerable insight into the myriad of sociotechnical arrangements that make up financial practices. These accounts have highlighted the role of machines in supporting collaborative financial work, such as the computer screens that bring together geographically-dispersed actors in the active construction of markets (Knorr Cetina and Bruegger, 2002), and the use of electronic trading systems in the formation of traders' identities (Zaloom, 2006). However, these studies are concentrated on the elites of 'high finance', such as hedge funds and institutional traders. Rather than viewing machines as facilitating financial work for these financial elites, this paper emphasizes their role in actively drawing lay investors into global financial systems via exposure to an international investment portfolio. This adds to a fuller understanding of non-human actors in aiding the financialization of everyday investors by examining the dynamics of sociotechnical agencement.

The ecologies concept has enabled geographers to probe deeper into the uneven material outcomes wrought by financialization. Coppock (2013) has shown how residents in poorer rural neighborhoods are disproportionately affected by restrictions in physical access to retail financial services, while Leyshon et al. (2004) apply the ecologies concept to describe the organization of retail financial services in different places. Financial ecologies have been applied to document how closer spatial and relational proximity to community-based lenders (as opposed to conventional lenders) have cultivated a different set of attitudes and behaviors amongst entrepreneurs (Carolan, 2019).

The emergence of the 'financial subject' or 'investor subject' (Aitken, 2007; Langley, 2007) under neoliberal governmentality presupposes investors as *homo economicus*, or rational actors who use financial markets to create wealth-maximizing portfolios (Erturk et al., 2007). This paper adopts a novel conceptualization of investor formation by using the ecologies concept to explore the role of robo-advisors in mediating human-algorithm interactions. Rather than being active, rational entrepreneurs who undertake calculative practices of risk-versus-return in portfolio construction, investors are disciplined by robo-advisor algorithms into passivity. Instead of simply conceptualizing robo-advisors as an alternative investing medium to conventional modes of financial wealth planning and management (e.g. Phoon and Koh, 2018), this paper situates robo-advisors as an emerging intermediary in producing new financial subjects and subjectivities. Mapping the emerging human-machine relations as shaped by robo-advisory algorithms offers a richer interpretation of subject formation.

The ecologies concept provides a useful framing device because it breaks down the global geographies of money and finance into smaller constitutive ecologies, as distinguished by varying combinations of financial knowledge and practices, institutional and governance structures. Grafe and Mieg (2019) operationalize financial ecologies as "a social structure in which actors, locations and their relations form geographically distinct constellations of knowledge, practices and subjectivities that enable the provision of financial services" (p. 502). As such, this paper details the evolving sociotechnical relations between individuals and algorithmically driven investing services. Robo-advisors can assess the financial situation of investors through simple questionnaires and recommend a suitable risk-calibrated portfolio, taking over the functions traditionally performed by human financial advisors. With the replacement of human agents with machines, the ecologies approach can illuminate the uncertainties and tensions in subject formation. It clarifies how investor subject formation, as intermediated by emergent machine-based technologies, can be contingent and incomplete, where investors are formatted by automated investing platforms into self-disciplined individuals whose investment practices and knowledge are reshaped by algorithms.

3. Robo-advisors: automating financial planning and investing

Robo-advisors are a fairly new phenomenon in the burgeoning fintech scene. Targeting investors with little financial knowledge or those

with a laid-back, hands-off investing style, successive iterations have seen the development of increasingly sophisticated robo-advisors with artificial learning and machine learning capabilities, further diminishing the role of human advisors (Tokic, 2018). The main features of robo-advisors are summarized by Investopedia (2019):

Robo-advisors are digital platforms that provide automated, algorithm-driven financial planning services with little to no human supervision. A typical robo-advisor collects information from clients about their current financial situation and future goals through an online survey and then uses the data to offer advice and automatically invest client assets.

There are around 300 robo-advisories worldwide, with startups like Betterment and Wealthfront vying for market share with established financial institutions like Vanguard, Charles Schwab and BlackRock (Phoon and Koh, 2018). Their main value proposition is that they allow the mass market to invest at low cost, using a diverse menu of exchange-traded funds (ETFs) covering different geographies and industries. Professional financial advisors can charge hefty annual management fees of at least one percent of assets under management, while robo-advisors charge only a fraction of one percent in fees and require low minimum starting balances. When algorithms automate portfolio creation, investors are not subjected to potential conflict of interests where human advisors may be financially incentivized to promote unsuitable products to their clients (Lai, 2016). As investing paradigms governed by code, robo-advisors overcome sub-optimal investing behaviors, such as the cognitive and affective mistakes (Benartzi and Thaler, 2007) and portfolio over-trading (Barber et al., 2009) that may affect do-it-yourself (DIY) investors.

There are currently about 13 robo-advisor firms in Singapore, consisting of startup firms and incumbent financial institutions (Table 1). Per local regulatory requirements, all robo-advisory firms have implemented data collection frameworks to determine each client's risk profile and investing knowledge and experience, in order to make suitable investment recommendations. Fig. 1 provides a typical example of client data collection and risk assessment, using a short questionnaire comprising questions on age, income (or net worth), investing goals and familiarity with investing. The data is then processed by an algorithm to generate an investor risk profile that is matched to a recommended portfolio with the appropriate asset allocation (Fig. 2). The portfolio is set up through a brokerage after the investor accepts the portfolio recommendation and funds the account.

The catch-all term of 'robo-advisor' belies the pluralistic practices behind its implementation. Other than the differences in fee structure, minimum investment balance and platforms of access as elaborated in Table 1, the investment philosophies and trading strategies of robo-advisors also differ. Table 2 summarizes the main asset classes that are used by robo-advisors to construct portfolios, as differentiated by the number of portfolios offered, types of securities used, underlying assets and geographical focus. Most robo-advisors use mainly ETFs and fixed income (bonds) to construct portfolio assets, although some also include alternative assets like real estate and commodities e.g. gold. The "black box" nature of algorithms (Geiger, 2017) means that the same investor may be sorted in different ways across robo-advisors. The risk quantification process and the matching process between risk and asset allocation are governed by parameters that are unknown to the investor. Portfolio rebalancing strategies also differ across robo-advisors. Depending on the specific algorithmic configuration, some robo-advisors rebalance when the target asset allocation is unbalanced, while others employ a risk-based rebalancing approach. This significant heterogeneity in operations among robo-advisors means that investors are enrolled into financial markets differently, as reflected in varying exposures to different mixes of asset classes, securities instruments, industries and geographies.

Table 1
Overview of robo-advisors in Singapore (all amounts in Singapore dollars unless otherwise indicated).

No.	Firm	Type	Founded	Minimum balance	Annual fees	Human advisor	Model
1	StashAway	Start-up	2016	None	0.8% (up to \$25,000), decreases down to 0.2% (> \$1 mil)	No	Economic Regime-based Asset Allocation
2	Smartly ^a	Start-up	2015	\$50	1% (< \$10,000)/0.7% (> \$10,000)/0.5% (> \$100,000)	No	Black-Litterman
3	AutoWealth	Start-up	2015	\$3,000	0.5% + US\$18 per annum	Yes	MPT ^b
4	DBS digiPortfolio	Bank-based	2019	\$1,000 or US\$1,000	0.75%	No	MPT ^b
5	OCBC RoboInvest	Bank-based	2018	US\$2,500	0.88%	No	MPT ^b
6	UTrade Robo	Brokerage-based ^b	2018	\$5,000	0.88% (up to \$50,000)/0.68% (\$50 K - \$100 K)/0.5% (> \$100 K)	No	MPT
7	Phillip SMART Portfolio	Brokerage-based	2017	\$5,000	0.5% + SGX clearing and trading fees where applicable	Yes	MPT
8	MoneyOwl	Start-up	2018	\$100	1.14% to 1.20%	Yes	MPT ^b
9	EndowUs	Start-up	2017	\$10,000	0.6% (up to \$200,000)/0.5% (\$200 K - \$1mil)/0.35% (\$1m-\$5mil)/0.25% (> \$5 mil)	No	MPT
10	Kristal.AI	Start-up	2016	\$100	Free (up to US\$50,000); 0.3% (> US\$50 K)	No	MPT ^b
11	SquirrelSave	Start-up	2019	None	0.5% management fee + performance fee (10% of any positive return)	No	MPT
12	FSM Managed Portfolios (MAPS)	Start-up	2016	\$1,000	0.35% (conservative portfolio)/0.50% (all other portfolios)	No	MPT
13	Syfe	Start-up	2019	None	0.65% (< \$20 K)/0.5% (> \$20 K)/0.5% (> \$100 K)	Only for premium plans	MPT

^a Inferred based on description of the firm's investment philosophy and portfolio creation principles.

^b Smartly announced its closure in March 2020, citing intense competition.

^c UTrade Robo is an affiliated company of the homegrown UOB banking group that also includes UOB Bank.

3.1. Methodology

This paper draws mainly from the data collected from robo-advisor websites as an *invested client*. As a relatively new subsector in the domestic finance scene, there is not a lot of publicly available information about robo-advisors. Information was limited to those from robo-advisory firms' websites, a few regulatory documents and articles in the financial press. Internal information is not easily available because algorithmic operations and client engagement practices are considered sensitive information that allows each firm to differentiate themselves from other competing robo-advisory firms. Unlike in the USA, licensing applications and regulatory filings submitted to the financial regulatory authority (MAS) are unavailable to the public. The nascent nature of robo-advisors introduced difficulties in gaining access to actual users, who represent a small (but increasing) proportion of the investor community, where the majority of investors (61 per cent) prefer to obtain financial advice from human agents (Tan, 2017).

The dearth of publicly available information on robo-advisors and difficulty in accessing robo-advisor investor subjects presented significant methodological challenges. Lange et al. (2019) argue that algorithmic trading presents methodological challenges for researchers, as their internal operations are obscured in opacity due to their confidential and proprietary nature. A different approach was thus required. I assumed the role of a paid investor to gain access to the automated investing service. Following Lange et al.'s suggestion, I treated the algorithms as ethnographic objects to probe the entanglements in the human-machine/trader-algorithm relationship. This was done by opening and funding accounts with four local robo-advisors (AutoWealth, StashAway, Kristal.AI and MoneyOwl) to gain insider access to their web- and application-based interfaces. These four robo-advisors were selected based on their relative popularity in discussion threads on financial forums and coverage by financial blogs. During the account opening process, I underwent a customer assessment ("know your customer") process that profiled my risk tolerance and investment horizon. I then accepted an asset portfolio as determined by the algorithms.

Becoming an active participant-observer conferred several methodological benefits (Johnson et al., 2006) in teasing out the entanglement between algorithms and humans. It enabled me to access the robo-advisor user platforms and interact with the different features and processes. My interactions with the robo-advisor user platform from account set-up and funding, investor profile creation, to portfolio selection and monitoring were recorded using field notes and screenshots, where I explored different parts of the website and user interface, such as company information, help and support and the client portfolio dashboard. I was also able to verify the reliability of collected information against robo-advisor articles in the popular press. Assuming a position as an actual investor also allowed me to experience and reflect on the interactions with the investing platforms that go into constructing passive investor subjectivities. I also looked at popular online financial forums and blogs that contain articles and discussion threads on robo-advisors. This allowed me to identify the main actors who provide free financial advice online and the commonly cited factors in choosing a robo-advisor, so as to map how the decentralized information ecology of online financial advice provision lead to greater uncertainty in investor subject formation.

4. The 'McDonaldization' of lay investing

Ritzer (1983) argues that modern society is now governed by a "McDonaldization" effect. This phenomenon is predicated on convenience, efficiency, calculability, predictability (standardization) and the use of technology as a form of control. These characteristics are seen in robo-advisors, too. Robo-advisors are designed to appeal to the masses i.e. lay investors with little investing experience. Therefore, robo-advisors offer investing with low fees, are simple to use and highly

Investment Goals

House
Car
Children Education
Retirement
General Investing

I am looking to cash out my investments in 15 years with approximate value of S\$ 100,000.

Personal Information

I am 25 years old.

My annual income (including other sources of income such as rental income) is approximately S\$ 50,000.

My estimated net worth is approximately S\$ 50,000.

Investment Information

I am looking to invest an initial amount of S\$ 10,000.

I am looking to top up my investments with S\$ 0 /month.

The estimated value of my current investment portfolio is S\$ 10,000.

Risk Assessment

I have invested before in / through (you can choose more than one):

Fixed Income (Bonds)
Equity (Stocks)
Commodities / Forex / Derivatives
Mutual Funds (Unit Trust) / Financial Planner
None of the Above

Composition of your existing investment portfolio (if applicable):

Equity (Stocks):	<u>0</u> %	▼	Mutual Funds (Unit Trusts):	<u>0</u> %	▼
Fixed Income (Bonds):	<u>0</u> %	▼	Alternative Investments (Others):	<u>0</u> %	▼
Forex / Commodities:	<u>0</u> %	▼			

When investing, my priorities are:

☐ Maximising my potential gain
☒ Equal emphasis on maximising gain & minimising loss
☐ Minimising my potential loss

I understand that markets are at times volatile. If my investment portfolio loses 10% of its value, I would:

☐ Buy more
☒ Do nothing
☐ Sell parts of my portfolio
☐ Sell everything

Fig. 1. Sample customer risk assessment questionnaire (from AutoWealth).

accessible. Many operations are performed by automated code, making it easy to scale up robo-advisor services. Accounts can be conveniently set up online in a matter of minutes. Customer risk assessment and investment portfolio recommendation are streamlined by algorithms without the need to meet with a human financial advisor. Financial objectives are measured using quantitative indicators, framed in terms like expected rates of return, asset correlations and volatility, which go

toward the projection of estimated portfolio values according to a prespecified time horizon. The robo-advisory experience is highly standardized; all investors go through the same mechanics of risk assessment and portfolio recommendation and selection.

Robo-advisors construct a suggested portfolio by assigning weights to a fixed menu of assets of varying risk. These weights are tied to an algorithmically assessed risk level that is calculated based on the

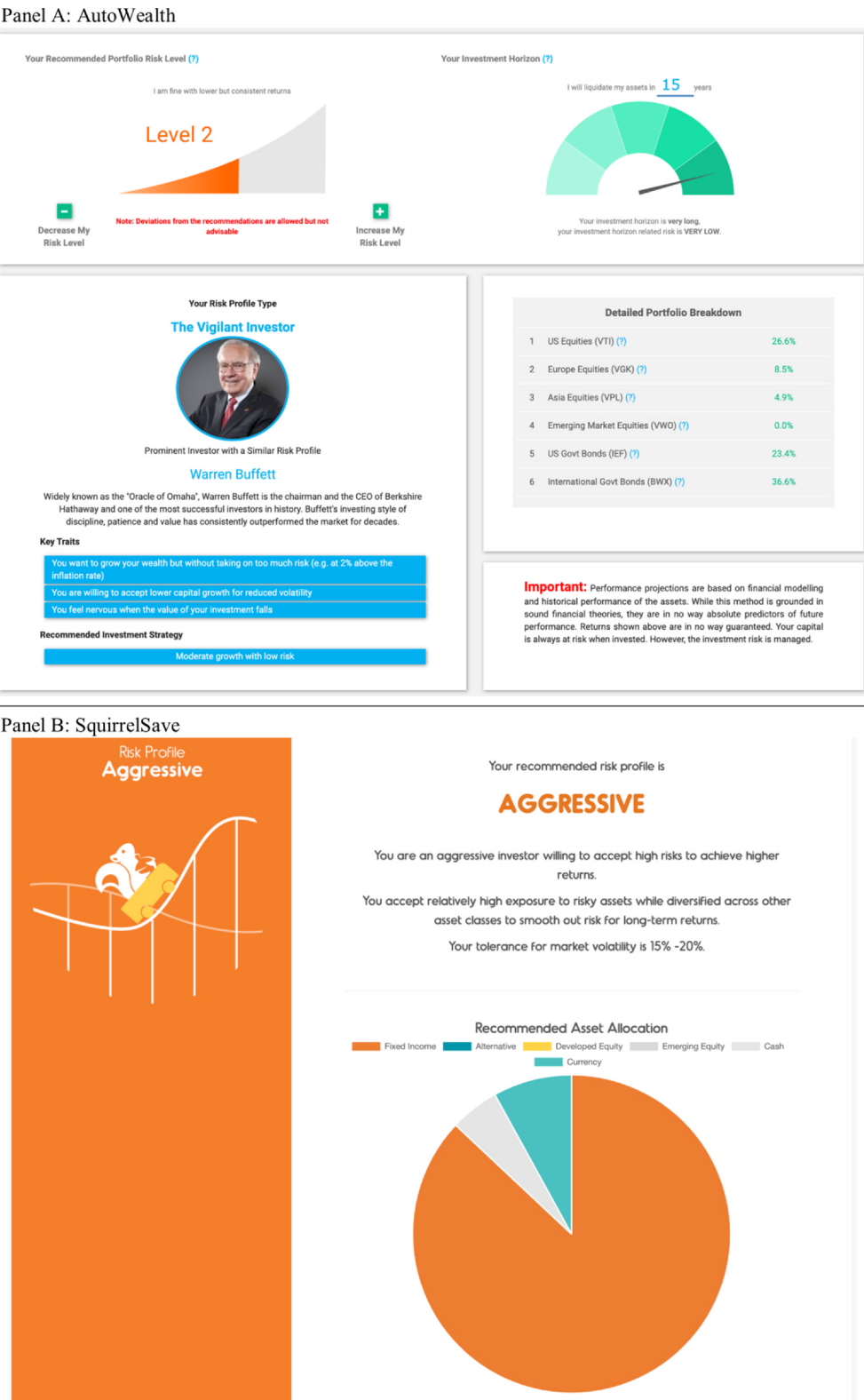


Fig. 2. Investor risk profiles and portfolio recommendations (AutoWealth and SquirrelSave).

investor’s responses to a generic questionnaire. The portfolio composition is generally fixed after inception. Although this does not preclude the individual from setting up multiple portfolios or accounts with varying risk levels (and different asset allocations), this constraint is implemented to keep the investor focused on long term goals, instead of actively changing the asset allocation to ‘time the market’, such as

switching to an equity-heavy portfolio in a bullish market or fleeing towards the safety of bonds when the market is volatile.

Investors monitor their accounts using a standardized, clean-looking dashboard that summarizes key portfolio information visually that is easy to understand. A robo-advisor dashboard conveys calculability, providing a broad overview of the account status and portfolio

Table 2
Portfolio choices, asset types and geographical scope.

Firm	Portfolio securities	Underlying assets	Geographical scope
StashAway	ETFs	Equities, fixed income, real estate, precious metals (gold)	Global
Smartly	20 portfolios in ETFs	Equities, Government bonds, Corporate bonds, Commodities, Real estate, Cash	Global
AutoWealth	Index-tracking ETFs (MSCI All-Country World Index, FTSE World Government Bond Index, MSCI World Index)	Stocks and bonds	Global
DBS digiPortfolio	6 portfolios in ETFs	Equities, fixed income, cash	Asia (Singapore-focused) or Global
OCBC RoboInvest	28 portfolios (stocks and ETFs)	Fixed income, equity, commodity, real estate, cash	Global
UTrade Robo	ETFs	Equities, fixed income, commodities	Global
Phillip SMART Portfolio	Mainly ETFs, but also unit trusts, closed-end funds, investment trusts, business trusts and Exchange-traded note	Equities, fixed income	Global
MoneyOwl	5 portfolios in mutual funds	Equities, fixed income	Global
EndowUs	6 portfolios in mutual funds	Equities, fixed income	Global
Kristal.AI	ETFs, REITs	Equities, fixed income, Real estate, Alternative assets	Global
SquirrelSave	ETFs	equities, fixed income, commodities and currencies	Global
FSM Managed Portfolios (MAPS)	10 portfolios in mutual funds and ETFs	Equities, fixed income	Global
Syfe	ETFs	Equities, fixed income, commodities	Global

performance without offering excessive details. Graphs convey information like portfolio value, currency exposure and asset allocation. The investor dashboard is designed with few features that users can control to discourage active portfolio management. Fig. 3 offers a striking contrast between the user interfaces (UIs) of DIY brokerage firms and robo-advisors. The former's UIs are more cluttered and feature-rich, incorporating a smorgasbord of elements to capture both historical and current financial performance that push savvy investors to seek higher-than-average returns. On the other hand, robo-advisors' UIs keep lay investors focused on the future, projecting expected returns that commensurate with investors' stated goals.

The highly summarized portfolio information discourages investors from exploring their portfolio in detail. For instance, I tried to learn more about the individual securities in my AutoWealth portfolio by clicking on the obscured links in the asset allocation pie chart. These links opened up lengthy investor prospectuses consisting of tens of pages of highly technical financial jargon, such as NAV (net asset value), portfolio turnover and index sample risk. The target clientele of robo-advisors i.e. those with little to average investing knowledge would most likely find these technical documents difficult to read and interpret and refrain from further portfolio exploration. Collectively, these various design and operational elements illustrate how technology is used to domesticate investors into docile subjects by keeping them at a distance from their investments.

4.1. Machines as financial advisors?

Financial advisors are important intermediaries who integrate investors into international markets and shape investor knowledge and behaviors (Lai, 2016). They assess each customer's unique financial situation, understand future needs and work with the client to reach stated financial goals. These often take place over face-to-face meetings and phone calls that nurture the client-advisor relationship over time. Through regular contact, financial planners are apprised of key developments over the client's different life stages, such as marriage and starting a family, which require different financial products to be recommended. The client-advisor relationship becomes impersonal when robo-advisors assume the functions traditionally performed by human agents. Emphasizing efficiency and convenience for clients, investors no longer need to consult regularly with their robotic advisors. Presumably, the only time when the investor "interacts" with the robo-advisor is during account opening, where the individual is guided along

in risk profiling and portfolio recommendation. After the portfolio is set up and funded, algorithms will take care of managing the client's investments without any additional input from the investor.

This distancing of client-advisor relations also means that the financial advice and solutions offered are less customized when only risk metrics are used to match clients to portfolios. Robo-advisors can only change risk profiles² or set up additional portfolios that are tied to new risk preferences as a rudimentary response to significant changes in the client's life circumstances that might impact future financial goals; specific product advice like education endowment plans are not offered. This simplistic method of capturing an investor's risk-taking capacity is inadequate (Faloon and Scherer, 2017) and imposes normative limits on how much risk an investor can take. Choice is constrained when robo-advisors only allow customers to select from a limited range of portfolios. An investor keen on socially responsible investing (SRI), such as avoiding companies that deal in firearms or fossil fuels, may find it difficult to invest ethically³ using robo-advisors.

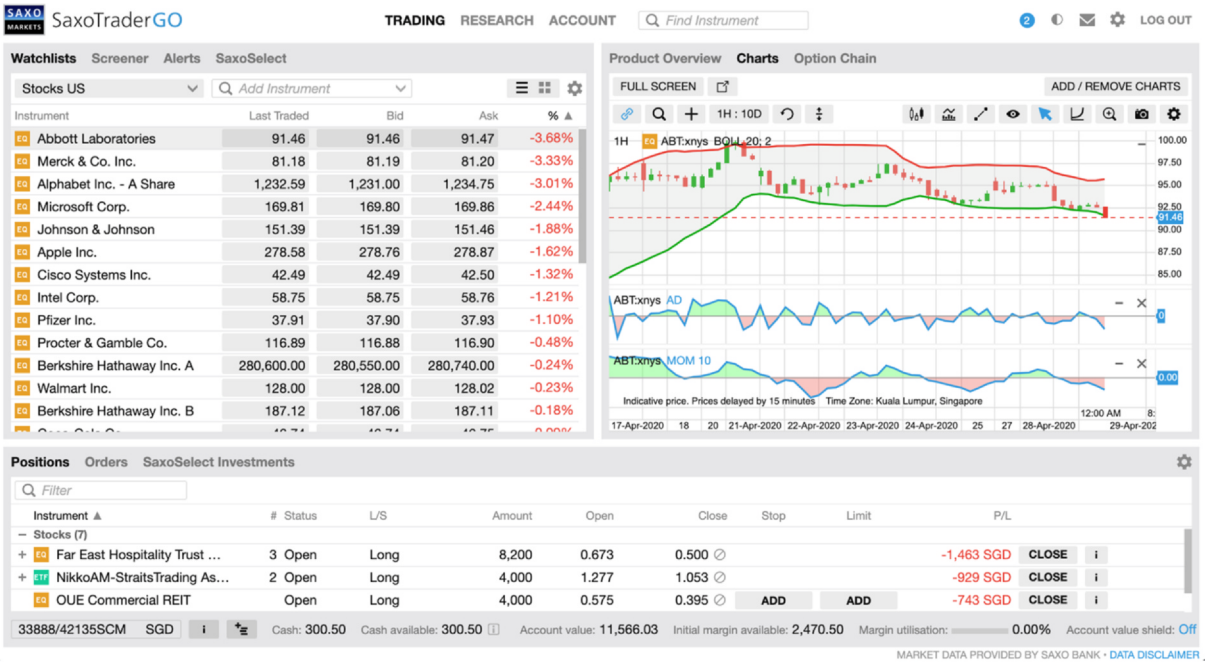
Some robo-advisors have re-incorporated human advisors to retain the human touch. This hybrid approach may appeal more to beginner investors who are more nervous about investing and would appreciate advice by a human operator. In this reconfigured role, human agents are generally unable to override the algorithmically determined asset allocation or change the preassigned risk profile (Hayes, 2019). Rather, their main role is to reassure investors to stay focused on long-term financial objectives. Instead of building more permanent client-advisor relationships through regular contact and to broaden the client's financial knowledge, human advisors are activated only when necessary to 'nudge' the client into sticking with the robo-advisor's recommendations. For instance, MoneyOwl bills itself as a "Bionic Financial Advisor", where client advisors should help investors to "understand, remind and risk-coach them about volatility and long-term returns, to help them stay invested."⁴ Each investor is treated as an automaton by the roadvisory algorithm, whose investments can be

² Changing the risk profile is often difficult and requires overriding of the original client settings that can only be done by the robo-advisor firm.

³ A handful of robo-advisors in North America like Betterment, Personal Capital, WealthSimple and Swell have begun to offer SRI portfolios, which are either generic or grouped by themes such as "Green Tech" and "Disease Eradication". However, these portfolios are only available to investors in that region.

⁴ <https://advice.moneyowl.com.sg/the-right-way-to-invest/>.

Panel A: SaxoTraderGO



Panel B: AutoWealth

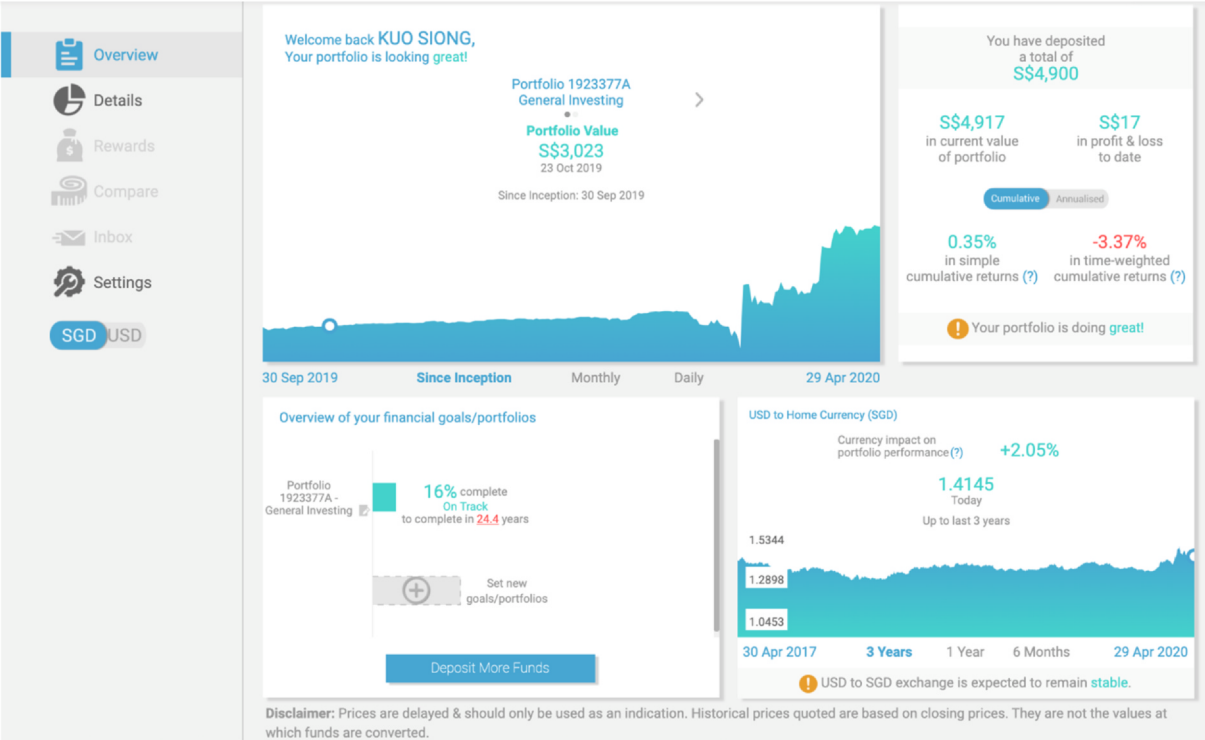


Fig. 3. User interface of a DIY platform (SaxoTraderGO) and a robo-advisor (AutoWealth).

optimized automatically without establishing more durable relationships between the robotic advisor and the client.

4.2. 'Locking in' investors: algorithms and financial theories

The transformation of financial advisory from one that relies on

human advisors to one that is fully run by machines requires a deeper interrogation into how the substitution of human knowledge practices with algorithms alters power dynamics between users and robo-advisors. Robo-advisor firms use varied tools in enacting algorithmic performance and control over investors. Studies have brought the social power of algorithms into focus, where they have the 'capacity to shape

social and cultural formations and impact directly on individual lives' (Beer, 2009: 994). Scholars studying high-frequency trading have drawn attention to the agential capabilities of algorithms in effecting profitable trading strategies by exploiting information asymmetries in a sociotechnical assemblage (Zook and Grote, 2017). Robo-advisors represent algorithmic power in action by exhibiting contrasting agential characteristics. Besides optimizing investment performance, algorithmic power is manifested in the subtle disciplining of passive investors. Not only do robo-advisor algorithms aim to *maximize* portfolio returns for a given risk tolerance, but also the effectiveness of this function relies on formatting investors into passivity by *minimizing* investor interaction with their portfolios. This echoes Seaver's (2019) argument that algorithms trap individuals and dictate their lives. In order to achieve the optimal returns that are needed to guarantee future financial security, minimal investor intervention is required and let the algorithms do their work of investment management.

The hidden logic behind robo-advisor algorithms is seen only from the implicit exhortation to investors to refrain from actively managing their portfolios to avoid compromising returns, but also from the closely guarded proprietary trading algorithms, which are informed by modern financial theory that lay investors would struggle to understand. Robo-advisors employ the strategic use of algorithms governed by contemporary financial theory to constrain investor agency. Trading algorithms are guided by a set of rules. These rules are based upon the Nobel Prize-winning Modern Portfolio Theory (MPT) developed by Harry Markowitz in 1952. The MPT frames investing as essentially a trade-off between risk and expected return for the risk-averse individual, which emphasizes a diversified portfolio in optimizing returns. Using mean variance analysis to assign weights to assets, MPT shows the ideal combination of assets to construct an optimal portfolio that maximizes the total expected return for a given level of risk, or a portfolio with the lowest risk given a specified expected return. Robo-advisor often mention either the MPT or its variant (e.g. the Black-Litterman model) in describing investment methodology. For example, StashAway's investment strategy states: "Our strategy, ERAA (Economic Regime-based Asset Allocation) enhances MPT by addressing external economic forces, which ultimately drive asset class' returns, volatility, and correlations."⁵ Invoking award-winning financial theory assures investors of the robustness of the trading algorithms. This supports the social power of algorithms, since the application of financial theory conjures positive financial imaginaries, where these "fictional expectations" (Beckert, 2013) motivate investors to relinquish control of their portfolio to the wisdom of theory-driven algorithms.

While it is acknowledged that investment constitutes a neoliberal technology of the self under Foucauldian modes of governmentality, it is also assumed that investors are self-disciplined and rational subjects (Langley, 2007: 75). Under this biopolitical lens, investors are seen as calculative, risk-taking and financially literate entrepreneurs who regard financial investment as the key to securing their freedom and security toward retirement. A more nuanced interpretation of this biopoliticized mode of governance is required with roboadvising. Citing behavioral economic theories, investors are portrayed as irrational beings who are easily swayed by emotional distractions and psychological bias (Benartzi and Thaler, 2007). StashAway captures this depiction in a banner (Fig. 4) that reminds investors to "put data, not your emotions, behind your money." When juxtaposed against the objectivity and logics of financial theory and algorithms, investors are forced to acknowledge their status as individuals who make irrational choices when swayed by emotions.

By acknowledging their irrationality, investors have to change their investing practices or to accept certain limitations. When they relinquish control of their portfolios, agency has shifted from human

investors to machines. Investing decisions are delegated to algorithms that enact the performance of the rational investor on the client's behalf, who believe in the alleged rationality of investing algorithms. Further, using robo-advisors implies that modern financial theory combined with technology will create a more secure financial future if investors themselves participate *less* in managing their investments. SquirrelSave even equates investing without real-time and round-the-clock risk management (a feature that its robo-advisor offers) to speculating and gambling.⁶ Therefore, robo-advisors function as a tool of Foucauldian governmentality (Foucault, 1988) that keeps investors disciplined. Even though investors do not completely understand the 'black box' operations behind algorithms, they perceive algorithms to be objective and neutral mechanisms that are efficient and reliable (Beer, 2017). Robo-advisor firms position algorithms as impartial technologies that augment their authority as gatekeepers of financial knowledge (Gillespie, 2014) which, when combined with MPT, embeds investors within specific sociotechnical relationships that separate investors from their portfolios. Robo-advisor users implicitly accept that their "roboportfolios" will earn them only average market returns. The calculative, entrepreneurial investor who seeks ever-higher returns as envisioned under Foucault's biopolitical mode of governance is effectively constrained by algorithmic practices, because beating the market or chasing after excess returns ('alpha' in investing parlance) is impossible under a robo-driven investing strategy.

Investor subject formation may be incomplete and uncertain under robo-advisors. Investors who use robo-advisors to "automate" wealth accumulation are essentially relying on the algorithms to secure their financial future. However, the general lack of human (advisor) presence and the opaque workings of algorithms may inject greater uncertainty into the investor-robo-advisor relationship. This relationship becomes fraught with tension especially in volatile markets, as seen in the market upheavals triggered by the Covid-19 pandemic. While investors are worried about suffering greater portfolio losses by staying invested, robo-advisors issue corrective nudges to repeatedly remind investors to "stay the course" by keeping calm, urging them to "trust the algo" and refrain from liquidating their investments. Fig. 5 shows an email that was sent by the CEO/CIO of MoneyOwl in February 2020 to the firm's clients. The email framed current market volatility in a long-term perspective, reminding investors not to react emotionally and to let the algorithms rebalance the portfolio accordingly. Links and charts with statistical evidence of the long-term rise of the stock market encouraged investors to remain invested, and even reminded them to take advantage of low prices by investing more funds.

Even though investors appear to be subdued by algorithms, such algorithmic control can be resisted to some extent. Algorithms depend on user inputs to function. As a series of programmed steps that lead to specific outcomes, there are possibilities for users to intervene to shape the workings of algorithms (Velkova and Kaun, 2019). Knowledgeable investors can overcome the structural control of algorithms. They can "beat the algorithm" by answering the client profile and risk assessment questionnaire in a way that generates their desired risk level and associated portfolio allocation. In this case, investors are not following the algorithm's recommendations, rather, the algorithm is tricked into showing the portfolio desired by the investor. The potential for algorithmic resistance suggests the complexity of sociotechnical systems; the investor-robo-advisor relationship is not a straightforward one that is simply marked by the dominance of machines over human behavior. Instead, the financial ecologies of robo-advisors remain a contested terrain between algorithmic and human control (Kellogg et al., 2020), whereby the more experienced investors are able to reassert partial agency in choosing their portfolio and in subverting the algorithm's recommendations.

⁵ <https://www.stashaway.sg/r/stashaways-asset-allocation-framework> [accessed October 30, 2019].

⁶ <https://www.squirrelsav.com.sg/fully-ai.html>.

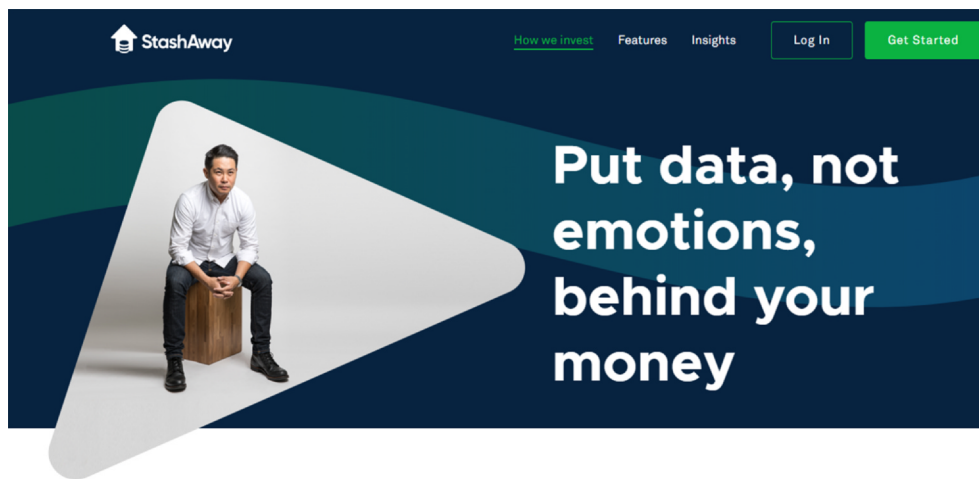


Fig. 4. StashAway marketing banner.

4.3. Pension investing with robo-advisors: The role of the state

The state remains an active agent in key institutional developments to support the robo-advisory scene. To transform itself into a fintech hub, the MAS has amended existing legislation in the Securities and Futures Act (SFA) and the Financial Advisors Act (FAA) to lower barriers to entry and stimulate further innovation. This was outlined in MAS's Guidelines on Provision of Digital Advisory Services [CMG-G02].⁷ Robo-advisors enjoy less stringent licensing criteria than other financial institutions. For example, the requisite five-year corporate track record has been replaced by less onerous measures, such as having a senior management team with relevant credentials and experience (Monetary Authority of Singapore, 2018).

Robo-advisor users are further articulated into global financial systems under two national investment schemes. The Singapore government has mandated the Central Provident Fund (CPF) program, a defined contribution pension scheme that helps citizens to save for retirement. Individuals enjoy attractive interest rates of between 3.5% and 5% on their CPF savings. Recognizing that such returns may be inadequate in meeting citizens' diverse retirement needs, the state introduced the CPF Investment Scheme (CPFIS) and Supplementary Retirement Scheme (SRS).⁸ This allows members to use part of their CPF funds to earn potentially higher returns by investing in a wide range of low-risk products such as bonds, unit trusts and ETFs.

This distinct and state-facilitated environment has helped robo-advisors to grow further by channeling funds from the state pension-finance scheme (totaling US\$288 billion)⁹ to the market. Currently, only US\$15 billion is invested under CPFIS, presenting a large remaining pool of capital for robo-advisors to tap into. Several robo-advisors such as EndowUs and Stashaway have been approved under the CPFIS that enables them to introduce customized plans that allow investors to invest their pension savings in a global, low risk diversified portfolio. Therefore, the state remains an important actor in the formation of financial subjectivities. Individuals are further articulated into global financial circuits through this unique state-market partnership, where the state plays an explicit role in normalizing risk-taking by encouraging citizen subjects to entrust their retirement savings to automated

robo-advisors in the hopes of achieving stronger future financial security.

4.4. Choosing the 'best' robo-advisor

The channels used by lay investors to obtain financial advice constitute an important element of financial ecologies. The ubiquity of the Internet and mobile-enabled devices has opened up access to a plethora of online financial communities. Individuals can obtain 'free'¹⁰ financial advice on these public forums instead of paying for advice by a professional wealth advisor. Online blogs and forums like Seedly and Go-Bear allow people to solicit personal finance advice from other individuals who are mostly ordinary investors, although some of them identify themselves as certified financial planners and other finance professionals.

Many of these websites publish articles and manage discussion threads to educate their readers on personal finance. Under this decentralized information environment, finance professionals are no longer the sole gatekeepers of financial knowledge since self-proclaimed investing gurus can also offer financial advice freely. This fragmented landscape of online financial advice may be confusing to investors seeking advice because of conflicting information provided by experts and novices. There are numerous robo-advisor comparison guides that select the "best" robo-advisor using various criteria. These criteria tend to be mostly quantitative e.g. robo-advisor fees and user ratings, as emblematic in a "metric society" where more aspects of social and economic life are being quantified (Mau, 2019). Others employ sophisticated methods like the back-testing of financial performance using historical data. This leads to different recommendations that complicate decision making. For instance, ValueChampion (blog) recommends the "best" advisor in several categories: Kristal.AI for lowest fees, StashAway for invested assets above US\$1.47 million and Endowus for its focus on unit trusts. Seedly uses real user reviews¹¹ for comparison - StashAway is the most recommended according to the number of user reviews, while Phillip Smart Portfolio is the top based on average ratings.

In a small market like Singapore, the financial system is centered on local banks. Most people living in the country have a retail banking relationship with at least one of the handful of local banks, as evident from the high proportion of adults (98%) who have access to financial

⁷ The guideline is available at <https://www.mas.gov.sg/-/media/MAS/Regulations-and-Financial-Stability/Regulations-Guidance-and-Licensing/Securities-Futures-and-Fund-Management/Guidelines-on-Provision-of-Digital-Advisory-Services-CMG02.pdf> [accessed March 12, 2020].

⁸ The SRS is a voluntary scheme that lets individuals add more money to their CPF savings above statutory contributions to earn certain tax benefits.

⁹ CPF Statistics, available at <https://www.cpf.gov.sg/Members/AboutUs/about-us-info/cpf-statistics> [accessed March 26, 2020].

¹⁰ These websites are profit-oriented and derive their revenue from affiliate links to commercial partners and sponsored advertisements.

¹¹ Seedly does not verify the reviews and a user account is not required to write or post a review. However, users can 'level up' their expertise when other users 'upvote' their posts based on their helpfulness.



Fig. 5. Email from MoneyOwl CEO/CIO dated 28 February 2020.

services (Bain and Company, 2019). These banks have a long history, establishing a strong branding and marketing presence through their extensive branch networks and strategic advertising on both mainstream media outlets and social media. This has allowed banks to cultivate deep trust and well-regarded reputations with consumers, which can be used to market new insurance and investment products (Lai and Tan, 2015) like roboadvising solutions. As Belanche et al. (2019) argue, subjective norms like general perceptions of trust can influence robo-advisor adoption decisions. Therefore, investors may choose a bank-affiliated robo-advisor because of ongoing financial relationships that foster the accumulation of knowledge-based trust (Koehn, 2003) with repeated interactions over time. Bank-based robo-advisors are perceived by investors to be less risky because they have better access to more capital, robust security systems and a well-integrated suite of

products and services, thus investors are more willing to go with a bank-affiliated robo-advisor.

These reputational advantages may explain why all three of the domestic banking groups in Singapore (UOB, DBS and OCBC) have ventured into the robo-advisory space. Likewise, brokerage-based robo-advisors such as UTradeRobo also enjoy reputational benefits (albeit to a smaller extent than banks) by leveraging on their history as brokerage firms and existing client relationships. Such reputational and trust advantages are not necessarily extended to start-up robo-advisors¹²

¹²An exception would be MoneyOwl, which is a subsidiary of NTUC Enterprise, a well-known and reputable organization in Singapore that serves up to two million individuals through its various social enterprises.

The figure displays five screenshots from the Seedly finance forum, illustrating free financial advice provided by community members and professionals.

- Top Left:** A question titled "If you have to pick one roboinvesting platform to invest in, which would you choose and why?" asked by an anonymous user. It has 7 answers and 0 comments. A user named Yh.Jens (Level 3, Wonderkid) answered 2 days ago, discussing Kristal.ai and its 0% fees for investments under 50k.
- Top Right:** A question titled "How do you guys think about the new Syfe 100% REITs portfolio? Is it better than their mixed reits with bonds? Why do you say so?" asked by an anonymous user. It has 4 answers and 0 comments. A user named Eliezer (Community Lead at Syfe, Level 5, Genius) answered 1 day ago, explaining the Syfe 100% REITs portfolio and its benefits.
- Middle Left:** A question titled "Could someone please explain in detail the appeal of Syfe's new REITs+ portfolio?" asked by an anonymous user. It has 2 answers and 0 comments. A user named Dhruv Arora (Founder & Chief Executive Officer at Syfe, Level 6, Master) answered on 26 Feb 2020, explaining the appeal of the REITs+ portfolio.
- Middle Right:** A question titled "What happens if a robo-advisor goes bankrupt?" asked by an anonymous user. It has 3 answers and 0 comments. A user named Amanda Ong (Head Of Client Engagement & Pr at Stashaway, Level 4, Prodigy) answered on 17 Jan 2020, providing clarity on the bankruptcy concern.
- Bottom Left:** A question titled "Was wondering if I should purchase a unit trust or trade equities to start my investment journey?" asked by an anonymous user. It has 6 answers and 0 comments. A user named Victor Lye (Founder & CEO at SquirrelSave, Level 5, Genius) answered on 21 Sep 2019, discussing the expense ratios for unit trusts and recommending SquirrelSave.

Fig. 6. Free financial advice on Seedly finance forum.

because of their short history, limited presence and general consumer unfamiliarity with robo-advisors. These standalone firms have to build their customer base from scratch through more active customer outreach, such as workshops, roadshows and financial websites. Fig. 6 shows how representatives from startups like Syfe, SquirrelSave and StashAway are using online forums like Seedly to engage potential

investors and promote their respective firms. In doing so, the opinions in these discussion spaces are further diversified, adding further complexity to lay investors' decision-making process with competing pieces of information.

Without a professionally trained human agent to recommend suitable products based on an intimate understanding of the client's

distinct financial situation, the onus rests on the individual to seek out proper financial advice, to do their own research by identifying and gathering relevant information from multiple sources and apply it correctly in decision making. Certainly, an individual could conduct exhaustive research on all robo-advisor firms by comparing fees, portfolio features, investing philosophies etc. However, the shift in epistemic authority towards more egalitarian modes of financial advice provision implies that individuals may navigate the complex information landscape via mental shortcuts to simplify decision making. These cognitive heuristics, such as overweighting average user ratings (de Langhe et al., 2016) or relying on perceived notions of trust and reputation (either from oneself or from others), may be unreliable. A novice investor may end up choosing a less suitable robo-advisor by going with the highest rated option.

This unevenness in investors connecting with the fragmented information landscape further highlights the uncertainties that go into subject formation. While the aim of the paper is not to untangle the nature of financial trust in the era of digital finance, online financial advice provision signifies changing trust relationships between providers and consumers (of information). Such relationships are marked by transient encounters between community members, causing trust to be more calculative than knowledge-based (Koehn, 2003) in the absence of more durable relations forged over repeated and familial interactions. The varying levels of trust and reputation perceived by investors towards different types of robo-advisors enrolls them into financial ecologies of varying risk and exposures to assets from multiple geographies (domestic, regional, international), as determined by the specific algorithms, portfolio offerings and trading strategies of each robo-advisor.

5. New technology, old problems?

5.1. New spaces of financial inclusion and exclusion

Despite robo-advisors' claims of disrupting traditional investing by democratizing access to *all* retail investors, a closer examination of robo-advisors suggests that this claim needs to be qualified. As fully online and always available investing platforms, robo-advisors necessitate a rethinking of new forms of financial exclusion beyond physical access to the financial system (Leyshon et al., 2008). Exclusion may be delineated by wealth factors, such as the imposition of minimum starting balances by many robo-advisors (Table 1) that constrain the availability of robo-advisor choices. Some robo-advisors target only wealthy individuals. Connect by Crossbridge Capital Asia caters exclusively to "Accredited Investors" with net personal assets of more than US\$1.47 million or annual incomes of at least US\$210,000, placing mass retail investors (which robo-advisors are meant to serve) out of this elite investing league.

Besides minimum funding requirements, robo-advisors can impose other barriers to participation. Other than excluding investors from actively managing their investments (see Section 4), robo-advisors present certain challenges that limit access and participation. Despite their innovative and disruptive nature, robo-advisors remain strongly tethered to the traditional financial system. They rely on brokerage firms to serve as asset custodians and to execute orders on behalf of their customers. Investment banks, insurance firms and asset management companies are counted upon to roll out the financial products e.g. unit trusts, ETFs and bonds that form asset portfolios. Clients need to have a bank account to fund their robo-advisor account. For the unbanked who do not have a bank account, using robo-advisors to invest and grow their wealth becomes a significant challenge. While the bank account requirement is not a problem for most Singaporeans (only 2% of adults are unbanked), the problem becomes more pronounced when extended to Southeast Asia. Significant proportions of the regional population are unbanked, such as in Indonesia (51%), Philippines (65%) and Vietnam (69%) (Bain and Company, 2019). Robo-

advisors remain embedded within the larger financial infrastructure where they still depend heavily on other traditional actors like brokerages and banks for their operations. This suggests that access to the formal financial system remains an important prerequisite to investing using robo-advisors. Therefore, the ability of robo-advisors to democratize investing for all needs to be qualified.

The digital nature of robo-advisors means that it will be more attractive to certain groups who are more digitally-savvy. A Deloitte report shows that this attractiveness differs across age groups and gender. In Singapore, older millennials between 25 and 34 years old showed the highest awareness of robo-advisors and greatest likelihood of investing with them. Women are also more likely to use robo-advisors than men (47% versus 26%) because the former view it as a less costly and less intimidating way to invest than DIY investing (Deloitte, 2019). The focus on key demographic groups like millennials who may be more receptive towards automated investing technologies may cause robo-advisor firms to neglect other groups in their client outreach. This unevenness in participation may generate greater wealth inequality through socio-spatial configurations of inclusion and exclusion (Langley and Leyshon, 2017), where robo-advisors' focus on targeting certain groups like the younger and digitally competent may cause other sociodemographic groups like the elderly and the unbanked to be excluded from participation. As such, robo-advisors may not truly represent a new egalitarian mode of investing. The same underlying problems of exclusion where certain social groups and individuals are unable to gain access (Leyshon and Thrift, 1995: 314) have simply been repackaged under the guise of technological innovation.

5.2. Wither financial literacy and education?

Besides helping clients with wealth planning and meeting financial goals, financial advising seeks to empower consumers with financial knowledge. Therefore, financial advisors serve as conduits that impart financial knowledge and educate customers (Lai, 2016) to become more confident consumers in the marketplace. Even in many developed economies including Singapore, raising financial literacy levels remains an ongoing challenge (Lusardi, 2019). Research has shown that improved financial literacy increases participation in the financial system and leads to healthy financial habits such as wealth accumulation through savings and investing (Lusardi and Mitchell, 2014). The digitalization of retail financial services under fintech is not an antidote to poor financial literacy; it may even promote certain risky financial behaviors like overspending (Lusardi, 2019).

Robo-advisors may undermine efforts to promote greater financial literacy through financial education campaigns undertaken at different levels (national, community, etc.) that target different constituencies. Customers need basic financial knowledge to understand how robo-advisors work before investing with them. However, robo-advisor firms frequently emphasize that investors are not required to have much (or even any) investing knowledge to start investing with robo-advisors, using this as a selling point to entice investors to join. Smartly has proudly proclaimed that "anyone can be an investor", while SquirrelSave declares that "you do not need any knowledge except about your own risk tolerance and how much you want to invest".¹³ The passive attitudes inculcated in robo-advisor users further reduce investor motivations to acquire financial knowledge. Without helping customers to become more financially literate by educating them about key concepts like ETFs, dividends and management fees so that they are confident in using robo-advisors to manage their financial wealth, it is difficult to argue that robo-advisors are truly practicing financial advising when they do not engage investors in financial education. Interestingly, even though robo-advisors mainly target lay investors with

¹³ <https://www.squirrelsav.com.sg/blog/investing-gambling-speculating.html>.

little investing knowledge, they still put out highly technical white papers¹⁴ laden with financial jargon and mind-boggling equations to demonstrate the robustness of their algorithms and investment methodology, which would be of little interest to a passive investor with little need to acquaint himself or herself with the technical details behind investing.

6. Conclusion

Focusing on robo-advisors in the “financialization of everyday life”, this paper has utilized the “financial ecologies” concept to explore the changing relationships between investors, advisors (both human and machine) and the state. In studying this relatively new robo-advisory scene where data availability is scarce, a novel approach was adopted by securing private access to the proprietary robo-advisor platforms as a paid investor. I show how different elements of the socio-technological assemblage of robo-advisors, such as the social power of algorithms backed by modern financial theory, the portrayal of investors as irrational beings, state-enabled national pension schemes and a fragmented environment of online financial advice come together to shape financial subjects and call forth new subjectivities. The perceived objectivity of algorithms and Nobel-winning contemporary investment theory collectively exercise power over investors that make the latter captive to the agency of automated code. Such passivity is reinforced by making investors acknowledge the incompatibility between their irrational tendencies and investment optimization. Yet investors are able to reclaim partial agency by exploiting the algorithm’s internal logics to achieve a desired portfolio recommendation, highlighting how the potential for algorithmic resistance introduces more complexity to the investor-machine relationship.

By examining how state-mandated pensions saving schemes are directed to support a thriving robo-advisor industry, this paper renews perspectives into the active role of the state in reshaping responsible financial subjects, where individuals are articulated into global financial circuits that satisfy broader state objectives in pursuing economic growth and enhancing finance sector competitiveness. The fragmented and open nature of generally non-professional financial advice provided via community forums and blogs, together with subjective perceptions of reputation and trust associated with different robo-advisor firm types lead to more distinctive contours, which further shape the financial ecologies that emerge. This results in varied socio-material outcomes. Depending on the robo-advisor chosen, investors are articulated into financial systems at different scales through the consumption of investment products offered by domestic, regional and international markets that are put together by algorithms into a single risk-calibrated portfolio. These MPT-informed portfolios aim only for average returns that commensurate with algorithmically calculated risk levels, precluding chances of earning excess market returns for investors.

This paper challenges the alleged democratization of investing by robo-advisors by analyzing their role in financial inclusion and exclusion, as well as in financial literacy and education. Robo-advisors offer a more nuanced interpretation of financial inclusion and exclusion. While robo-advisors enable more lay investors to participate in financial markets, those investors are restricted from actively managing their machine-curated portfolios. New forms of financial exclusion may arise. The digital nature of robo-advisors and their embeddedness within the larger financial system keeps certain groups such as the less tech-savvy and the unbanked from participation. The passive stance imposed by robo-advisors reduces the need for investors to actively seek financial knowledge when they can just rely on robotic advisors to take care of

their portfolios. When coupled with the low consumer financial knowledge requirements that are touted as a main benefit by robo-advisor firms, this may weaken efforts to raise overall financial literacy levels.

This paper has hinted at the changing dynamics of the general wealth management industry with the entry of robo-advisors as a new disruptive innovation. Future research can address the ways robo-advisors shape industry practices and knowledge production. The mediating role of automated technologies in resolving tensions between investment firms, investment outcomes and investor expectations can be further explored by studying how investor subjects perceive robo-advisors as a tool of financial self-responsibilization. Another fruitful area would be to explore the inequality in sociomaterial outcomes. One example may be the emergence of a ‘core-periphery’ pattern in wealth accumulation, whereby sophisticated investors such as hedge funds and high-frequency traders dominate the share of (excess) market returns, while investors settle for middling trading profits. Besides robo-advisors, other algorithmic financial practices have emerged in the form of budgeting and financial wellness applications that instill further discipline into everyday financial subjects. Studying these new calculative technologies can help in further interrogating the increasing pervasiveness of algorithms in revealing how the financialization of the everyday continues to unfold in multifarious ways.

CRedit authorship contribution statement

Gordon Kuo Siong Tan: Conceptualization, Methodology, Investigation, Visualization, Writing - original draft, Writing - review & editing.

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¹⁴ See <https://www.syfe.com/static/docs/2019-ari-whitepaper.pdf> and <https://www.squirrelsave.com.sg/blog/factor-analysis-engine-whitepaper.html> for two examples.

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